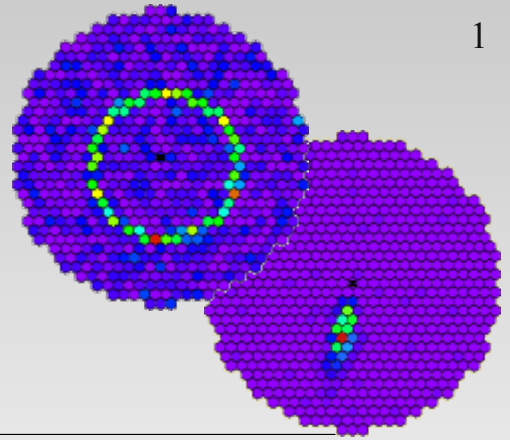
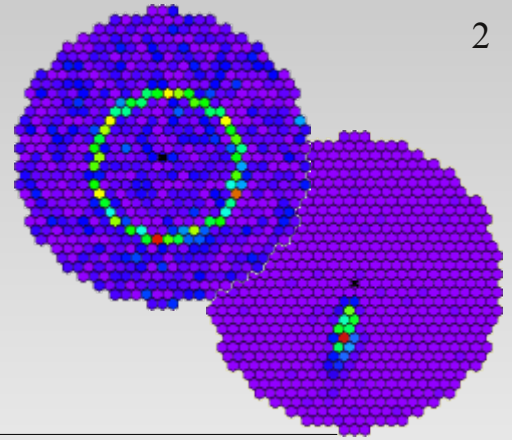
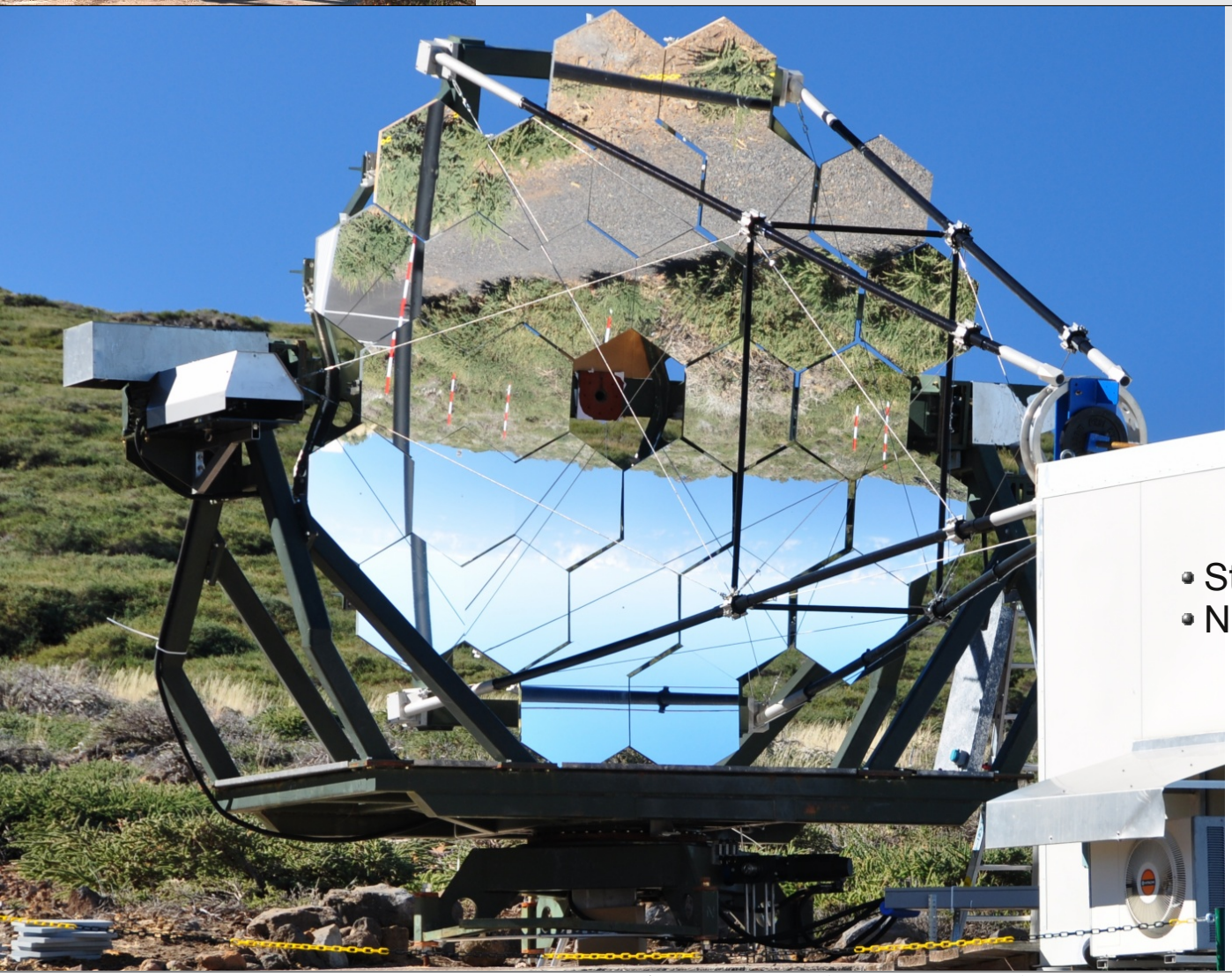


Requirements for
The FACT data storage and processing

Thomas Bretz

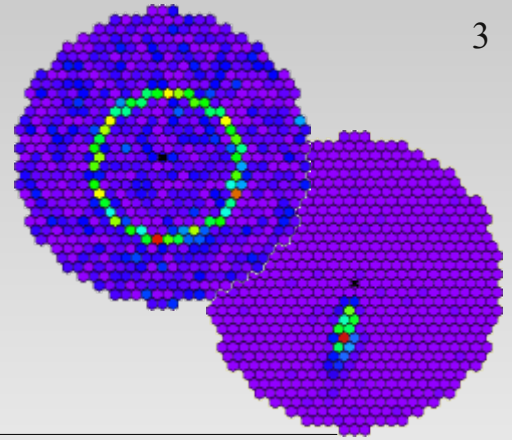
Amount of Data





- Storage size: O(100TB/year)
- Number of files: O(10^6/year)

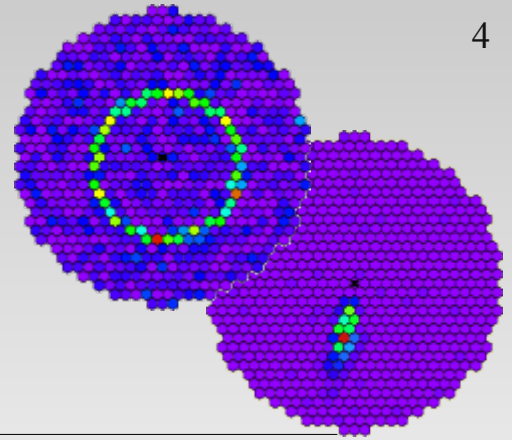
Access pattern



- End-user access („astronomer“):
  - Raw-Data: Very rare (not needed, no expertise)
  - Products: Rare („event-lists“)
  - End-products: Often (spectra)
- User access („cherenkov astronomer / analyser“)
  - Raw-Data: Average (needed for special analyses)
  - Products: Often (needed for standard analyses like own methods)
  - End-profucts: Rare (not needed)
- **Programmer's access** („cherenkov astronomer / developer“)
  - Raw-Data: **Very often** (needed to optimize the analysis, comparing algor.)
  - Products: **Very often** (needed to optimize the analysis, comparing algor.)
  - End-products: Very rare (*just* the end product)

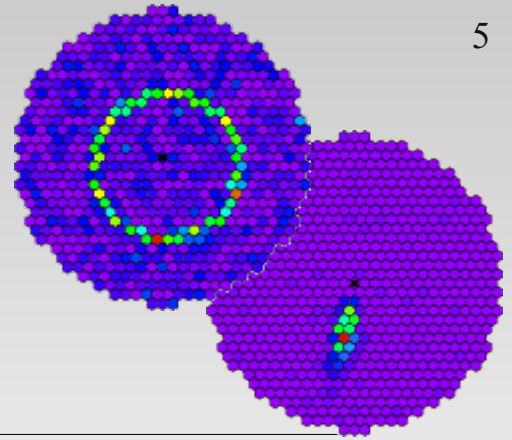
Most powerfull tool for the success of our analysis

Software access



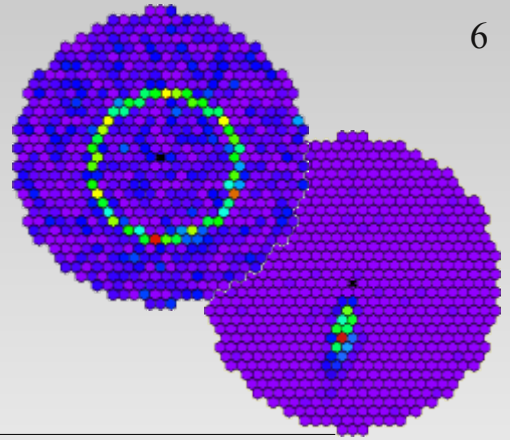
- Data stored in a unique structure, which is created from the key information (run number, observation night) [maintainability of the software]
  - /fact/data/2010 /factA/data/
  - /fact/data/2011 /factB/data/
  - /fact/calibrated/12345 /factC/calibrated/
- Data visible to the program should always be consistent,
  e.g. if raw data is accessible also the slow control data must be accessible
  [consistency of the output]
- For the software files should always be visible even if released from the cache
  [simplicity of the software]
- Possible staging of the files must be done transparently, i.e. hidden from the user
  [simplicity of the software, user friendliness]

Processing scheme



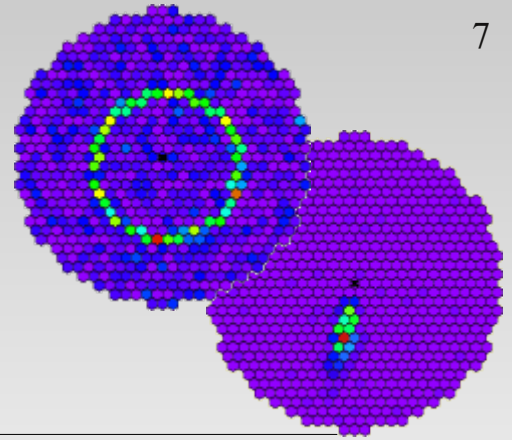
- Data arrival:
  - Up to 1TB per night, processing asap
- Data processing/re-processing:
  - All data of 5 years (~500TB) within two weeks
  - Reading: ~250MB/s (to 50 CPUs in parallel)
  - Writing: ~50MB/s (from 50 CPUs in parallel)
  - Writing: ~250MB/s (from Archive)
    (copying back 100TB easily takes days!)

Copies / Failure



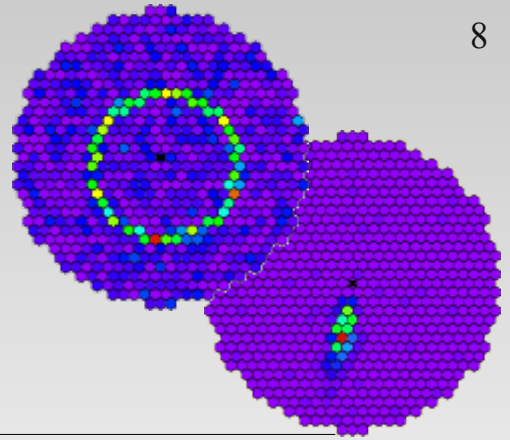
- Downtimes must be kept such that data-taking is never affected
- In the case of failure a filesystem check should be done within a reasonable time [reliability]
- At least two static copies of all files must exist, for performance reason they might be staged from their media to a cache [data safety]
- Copies should be maintained by the system, **not** by humans (consistency, completeness, error prove, maintainability) [data consistency]
- The copies should not be on the same media and seperated in space (in the ideal case in another room) [diversity, redundancy]
- In case of the failure of one copy the second copy should be accessible immediatly in a transparent way (copying back 100TB easily takes days!) [downtime, consistency]
- Creation of the new copy should not give raise to further downtime and not involve any manual process! (see above) [downtime, consistency]

General considerations



- Filesystem should have redundancy (e.g. RAID 5+2)
- System should be scalable in performance and size
  (e.g. ZFS sums the performance of all systems)
- Maintainability (e.g. cross-mounting of several file-systems is
  a horror for any system administrator and *high* risk in case of failure)
- The file system must be able to handle a large number of large *and*
  small files at the same time efficiently (e.g. „*find*“, data-access, etc.)

Conclusion



- A high-performance access to the data will allow us to
  - produce consistent results over the life-time of FACT
  - constantly improve the analysis
  - Re-produce optimized results on demand

This has never been done in Cherenkov astronomy so far!


Thank you!
Camera: Prototype-electronic available,
starting series production
FACT - First G-APD
Cherenkov Telescope
FACT
Mirrors: Installed
Drive: Installed